



# A new record for Guyana reveals the disjunct distribution of *Tragia cearensis* Pax & K. Hoffm. (Euphorbiaceae)

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## Abstract

*Tragia cearensis*, which was known only from northeastern Brazil in caatinga (dryland) vegetation, has its distribution expanded after the discovery of its presence in the savanna of Guyana, providing the first evidence of a disjunct distribution between those dry areas among *Tragia* species. *Tragia cearensis* could be recognized by having long, capitate, glandular trichomes at the apex of the petiole, the absence of glandular trichomes on the inflorescences and apices of the branches, and verrucose seeds. A detailed description, additional taxonomic notes, illustrations, and a distribution map are presented.

## Keywords

Plukenetieae, savanna, taxonomy, Tragiinae

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## Introduction

*Tragia* (Euphorbiaceae) comprises approximately 170 species, divided into *T.* subg. *Mauroya* Leandri (monospecific) and *T.* subg. *Tragia* L., which contain *T.* sect. *Agirta* Baill., *T.* sect. *Lassia* (Baill.) Müll. Arg., *T.* sect. *Leptobotrys* (Baill.) Müll. Arg., *T.* sect. *Monadelphae* L.J. Gillespie, *T.* sect. *Tagira* Müll. Arg., and *T.* sect. *Tragia* (Webster 2014). This infrageneric classification is the result of the revalidation of the old sections *T.* sect. *Bia* (Klotzsch) Müll. Arg. and *T.* sect. *Zuckertia* (Baill.) Müll. Arg. at the hierarchical level of genus, based on evidence from the pollen (Webster 2007; Medeiros et al. 2013).

The genus circumscription is uncertain due to molecular data that indicate a non-monophyletic assemblage (Cardinal-McTeague and Gillespie 2016). Also, the current morphological concept encompasses a lot of variation in flowers and pollen (Gillespie 1994; Webster 2014).

*Tragia* is largely recognized by its twining habit, stinging trichomes, and inflorescence spiciform or racemose (Webster 2014). The current circumscription of *Tragia* describes its species as globally distributed in tropical and subtropical regions (Webster 2014), with the African section *Tagira* and American section *Tragia*



diversifying into drier and more open habitats (Cardinal-McTeague 2018). Among the representatives of *T.* sect. *Tragia* recorded for the Neotropical region (35 spp.), 75% occur in South America (Govaerts et al. 2020), with peculiar geographic distribution patterns, as the populations of most species do not show disjunctions. Since the monograph of Pax and Hoffmann (1919), our knowledge about *Tragia* in South America essentially halted until Múlgura de Romero and Gutiérrez de Sanguinetti (1989) and Múlgura de Romero (1991) updated their occurrences to Argentina and adjacent areas; poorly known or endemic species, however, were not considered (e.g., *T. cearensis* Pax & Hoffm.).

*Tragia cearensis* was described by Pax and Hoffmann (1924) based on a specimen collected in Ceará state in northeastern Brazil. Santos et al. (2019) recently expanded the distribution of that species by recognizing new records in neighboring states. Morphologically, the species can be distinguished by the absence of capitate glandular trichomes on reproductive structures and the verruculose coat of its seeds (Santos et al. 2019).

During the taxonomic revision of *T.* sect. *Tragia*, we came across that material of *T. cearensis* collected in the savanna of Guyana. The first taxonomic treatment of *Tragia* for Guyana reported *T. tabulaemontana* L.J. Gillespie in Tabulaire areas in French Guyana, and the more widespread *T. volubilis* L. (Gillespie and Armbruster 1997). This paper contributes to a better understanding of *T. cearensis* and broadens its known area of occurrence. We also provide a morphological description, illustrations, its conservation status, and a comparative table of local species.

## Methods

Specimens housed in several herbaria with important collections from northeastern Brazil and Guyana were analyzed (ACAM, ALCB, ASE, BHCB, CAR, CEN, CEPEC, CESJ, CGMS, CSTR, CSTR, EAC, FLOR, FUEL, HESBRA, HRB, HRCB, HST, HUCS, HUEFS, HUESB, HUFRN, HURB, HUVA, HVSF, IAN, IPA, JPB, K, LIL, MAC, MG, MOSS, NY, PACA, PEUFR, R, RB, SMDB, SPSF, U, UB, and UFP) (acronyms according to Thiers 2020). We also examined type material from herbaria S available through the JSTOR Global Plants website (<http://plants.jstor.org/>) and the protologue (Pax and Hoffmann 1924). The morphological terminology used for the general description follows Radford et al. (1974); its conservation status is based on International Union for the Conservation of Nature (IUCN) criteria (IUCN 2019) considering its extent of occurrence (EOO) and area of occupancy (AOO), as estimated using GeoCAT software (Bachman et al. 2011). The map was prepared using QGIS v. 2.3 software (QGIS 2019).

## Results

***Tragia cearensis* Pax & K. Hoffm.** in H.G.A. Engler (ed.), *Pflanzenr.*, IV, 147, XVII: 186. 1924. (Pax and Hoffman 1924)

**Holotype.** Brazil. Ceará: Santo Antônio, 9 March 1910 (fl, fr), *Löfgren 188* (holotype S-R-10635!).

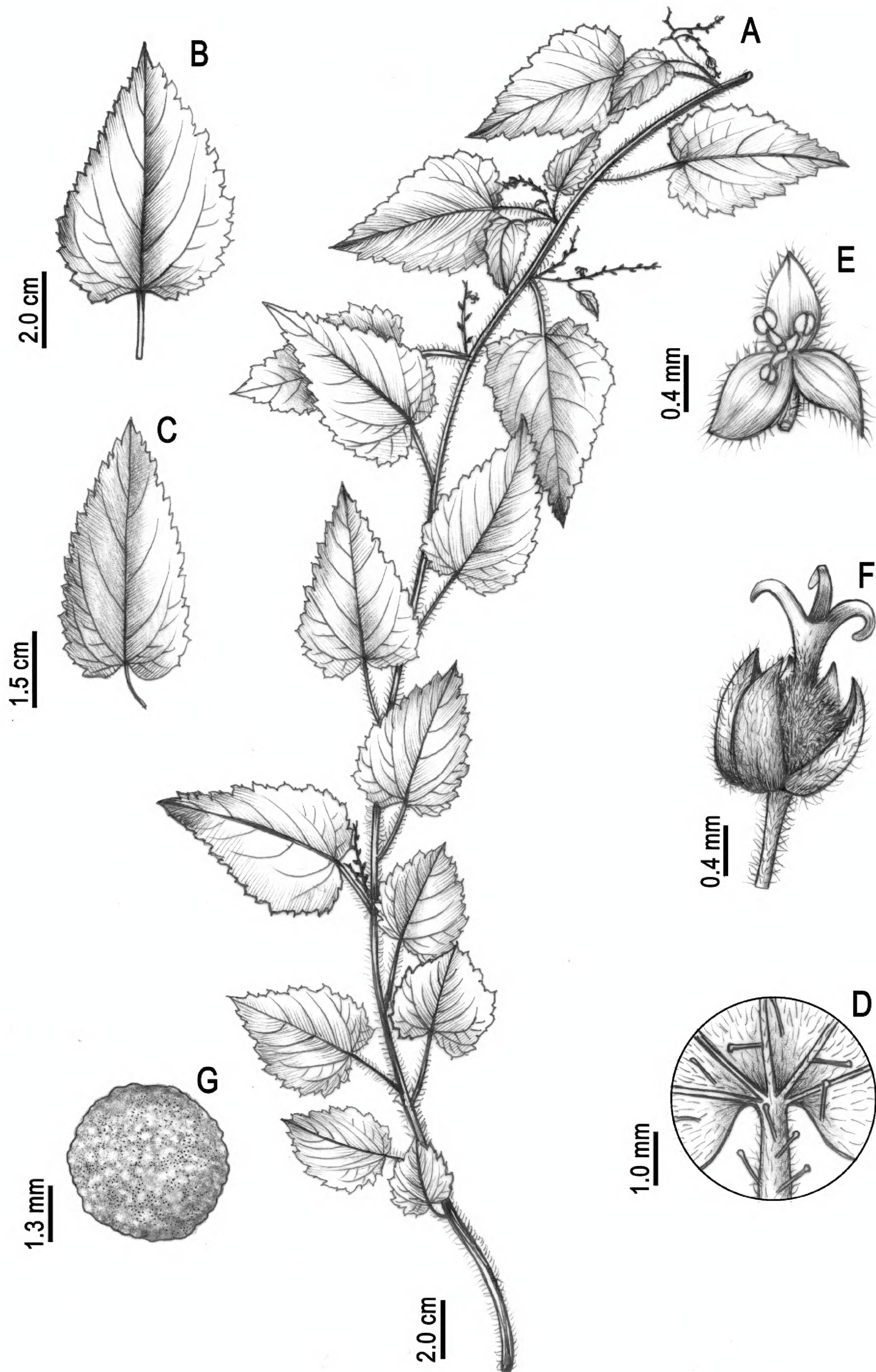
Figures 1, 2

**Identification.** Vine, villous or pubescent, older sections of the stem glabrescent. Stipule 3–4 × 1 mm, lanceolate; leaves alternate, petiole 2–3 cm long, pubescent, with long, capitate glandular trichomes at the apex. Leaf blade 3.5–6(–8.5) × 2.5–4 cm, oval or triangular-oval, base cordate, apex acute or acuminate, pubescent with stinging trichomes on the veins and simple trichomes on the lamina, primary veins basally actinodromous; margins biserrate. Inflorescence 2.5–4 cm long, pubescent with stinging and simple trichomes; bract up to 1 mm long, lanceolate, ciliate with simple trichomes; staminate flowers 15–20 along the rachis, pedicels shorter than the bracts, pistillate flower 1 at the base, pedicel shorter than bracts. Staminate flowers with calyx 3-lobate, lobes elliptic, ca 1 mm long; stamens (2–)3, filaments ca 0.5 mm long, thick at base, anthers elliptic, ca 0.2 mm long. Pistillate sepals 6, narrowly elliptic, ca 1.5 × 0.5 mm; ovary ca 0.8 mm long, 3-lobed, hirsutulose with stinging trichomes and few simple trichomes, stigmatic lobes up to 0.5 mm long, column up to 0.5 mm long, stigmatic surface smooth. Capsule ca 5 mm diam., 3-locular, pubescent with stinging and simple trichomes, sepals and column persistent on the fruit. Seeds ca 2.3 mm in diameter, spherical, dark brown-reddish, verrucose, papillae 50–100 µm.

**New record** (Fig. 3). GUYANA • Rupununi district, Datanawa; 02°49'N, 059°31'W; 09 Jun. 1995; fl., fr; M. J. Jansen-Jacobs et al. 4017 (MG 153490, NY 542137).

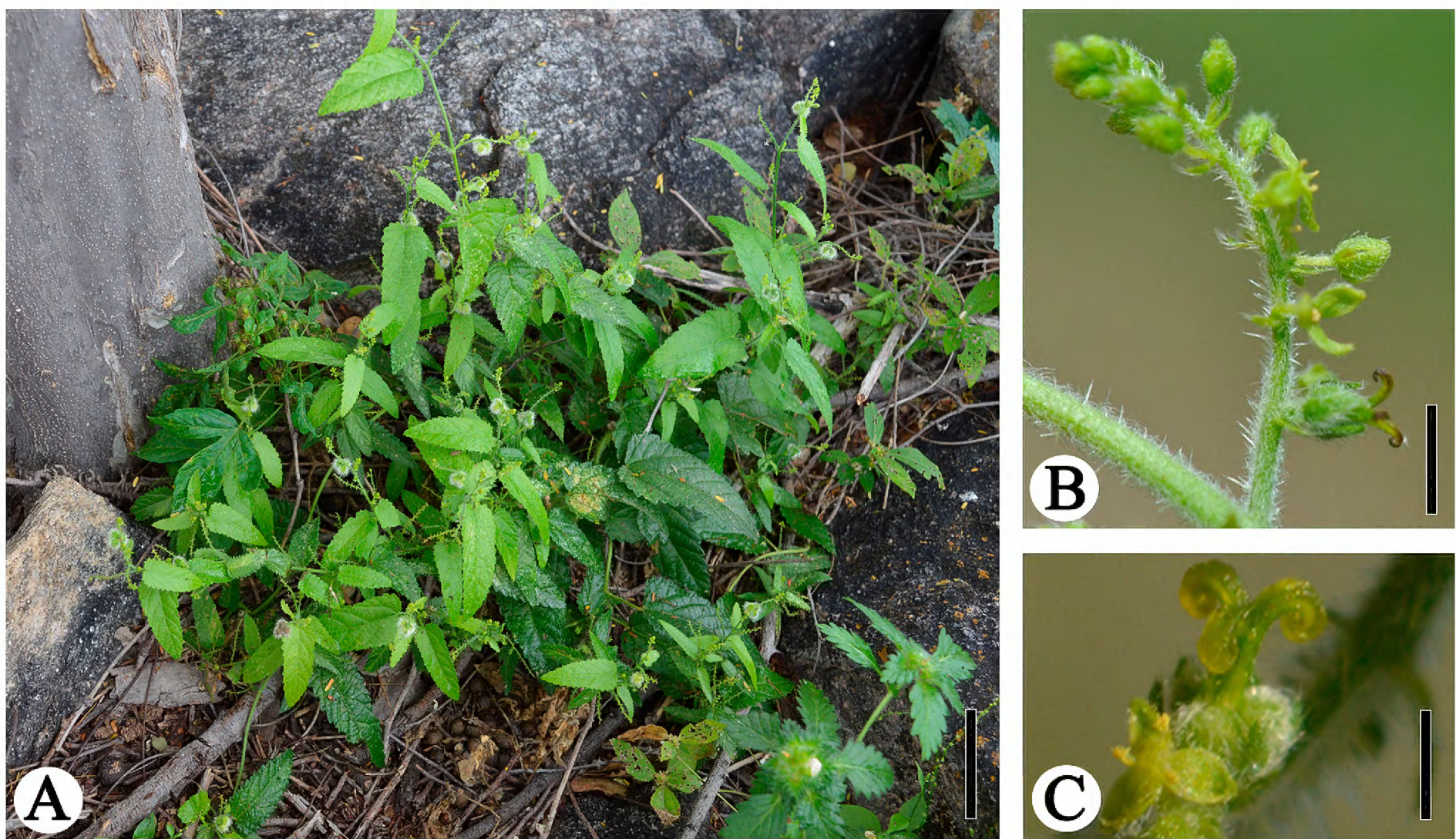
**Examined Material:** BRAZIL • Alagoas state, Olho d'Água do Casado, Fazenda Capelinha/Serra da Múmia; 09°31'42"S, 037°50'30"W; 28 Jun. 2000; fl; D. M. Coelho & R. Silva 406 (PEUFR 38207). • Alagoas state, Piranhas, fazenda Baixa da Légua; 09°37'25"S, 037°45'24"W; 11 Aug. 1999; fl., fr; R. A. Silva & D. Moura 807 (PEUFR 40807). • Alagoas state, Pariconha, fazenda Araticun; 09°15'14"S, 038°00'21"W; 25 March 2008, fl., fr; L. P. Felix 12175 (EAN 14020). • Bahia state, Uauá, Serra do Jerônimo, 09°43'23"S, 039°19'56"W; 30 Mar. 2000; fl., fr; N.G. Jesus et al. 920 (CEN 46017, CEPEC 102492). • Bahia state, Juazeiro, Morro do Mulato 09°44'40"S, 040°40'39"W; 26 Mar. 2000; fl., fr; M. L. S. Guedes et al. 7317 (ALCB 046816). • Bahia state, Monte Santo; 10°26'S, 039°19'W; 11 Jan. 2006; fl; M. L. Guedes et al. 12040 (CEPEC 113208). • Ceará state, Acarape; 04°13'27"S, 038°42'30"W; 03 Mar. 2001; fl; E. R. Silveira s.n. (EAC 30462). • Ceará state, Itaiçaba, Morro do Ereré; 04°40'28"S, 037°49'21"W; 10 Apr. 1982; fl., fr; E. P. Nunes s.n. (EAC 11164). • Ceará state, General Sampaio,





**Figure 1.** *Tragia cearensis*. **A.** Habit. **B, C.** Leaf blades. **D.** Detail of the leaf base and petiole apex. **E.** Staminate flower. **F.** Pistillate flower. **G.** Seed. From M. J. Jansen-Jacobs et al. 4017 (MG). Drawing by Regina Carvalho.





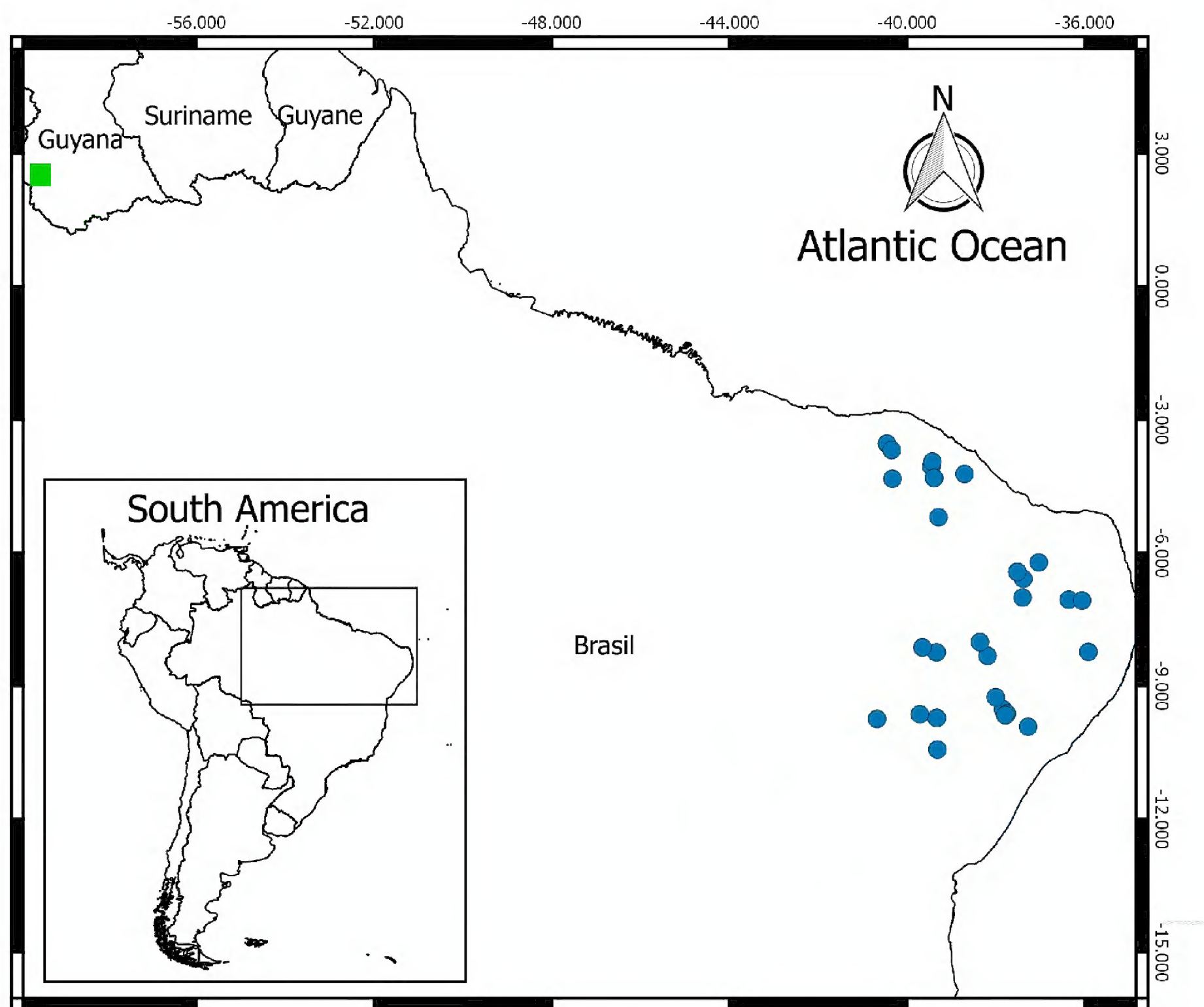
**Figure 2.** Specimens of *Tragia cearensis* in the field in Brazil. **A.** A specimen *in situ*. **B.** Inflorescence. **C.** Staminate and pistillate flowers. Scale bars: A = 7 cm; B = 0.8 cm; C = 0.2 cm.

RPPN Francy Nunes, fazenda Natalia; 04°03'10"S, 039°27'16"W; 27 May 2007; fl; M. F. Moro et al. 210 (EAC 043247). • Ceará state, Apuiarés; 03°56'56"S, 039°25'54"W; 15 Mar. 2008; fl., fr; E. Chaguinha s.n. (EAC 042386). • Ceará state, Meruoca, mata Fresca-Serra da Meruoca; 03°32'30"S, 040°27'18"W; 22 Jul. 1997; fl; A. Fernandes s.n. (EAC 25031). • Ceará state, Meruoca; 03°32'30"S, 040°27'18"W; 26 May 1994; fl; A. Fernandes s.n. (EAC 24572). • Ceará state, Meruoca, sítio Sr. Antônio; 03°32'30"S, 040°27'18"W; 25 Feb. 1981; fl., fr; A. Fernandes & P. Martins s.n. (EAC 9741). • Ceará state, Sobral, Macapá; 03°41'10"S, 040°20'59"W; 23 May 1981; fl; A. Fernandes & P. Martins s.n. (EAC 10270). • Ceará state, Quixeramobim, Assentamento Vista Alegre; 05°11'57"S, 039°17'34"W; 23 Mar. 2014; fl; L. B. Oliveira 182 (CEN 00086804). • Ceará state, Santa Quitéria; 04°18'57"S, 039°23'30"W; 24 Apr. 2012; fl; J. Paula-Souza et al. 10899 (EAC 054383). • Ceará state, Santa Quitéria, fazenda Intan de Cima-Serra do Pajé; 04°19'55"S, 040°09'24"W; 08 May 1997; fl., fr; M. A. Figueiredo s.n. (EAC 25552). • Paraíba state, Solenidade, comunidade Cachoeira; 07°03'26"S, 036°21'46"W; 21 May 2006; fl; R. F. P. Lucena & A. C. da Silva 225 (PEUFR 48200). • Paraíba state, Santa Teresinha, RPPN Fazenda Tamanduá; 07°00'27.4"S, 037°24'00.3"W; 03 May 2011; fl; D. S. Lucena et al. 86 (CSTR 3369). • Paraíba state, Pocinhos; 08 Jul. 1994; fl; L. P. Félix & A. M. Miranda 6555 (PEUFR 17212). • Pernambuco state, Betânia/Floresta, Fazenda Rebeca, Caldeirão do Gato; 08°19'16"S, 038°11'30"W; 07 Apr. 2001; fl., fr; K. C. Costa et al. 236 (PEUFR 36431). • Pernambuco state, Caruaru; 08°13'54"S, 035°55'13"W; 15 Aug. 2001; fl; E. L. Araújo

& E. Sampaio 437 (PEUFR 47371). • Pernambuco state, Serra Talhada; 07°58'15"S, 038°19'16"W; 01 Jun. 2006; fl., fr; M. F. A. Lucena et al. 1849 (PEUFR 40807). • Pernambuco state, Orocó; 09°38'12"S, 039°42'50"W; 27 Apr. 2001; fl; R. M. Harley et al. 54322 (ALCB 55202). • Pernambuco state, Cabrobó, Margens do Canal, próximo à estação elevatória; 08°14'35"S, 039°20'21"W; 25 May 2015; fl., fr; M. Oliveira & P. M. Ferreira 6130 (PISF 3035). • Pernambuco state, Mirandiba, Cacimba Nova; 08°08'01"S, 038°39'22"W; 31 Mar. 2006; fl; M. F. A. Lucena et al. 1186 (CSRT 452). • Rio Grande do Norte state, Serra Negra do Norte, Estação Ecológica do Seridó; 06°34'74"S, 037°14'54"W; 18 Apr. 2006; fl., fr; R. T. Queiroz 780 (UFRN 4085). • Rio Grande do Norte state, Jucurutu, RPPN Stoessel de Brito; 06°13'02"S, 037°02'04"W; 09 Mar. 2008; fl; A. A. Roque 480 (UFRN 7645). • Rio Grande do Norte state, Serra Negra do Norte, Estação Ecológica do Seridó; 06°24'11"S, 037°15'60"W; 14 Apr. 2006; fl; R. T. Queiroz 677 (UFRN 042011). • Sergipe state, Porto da Folha, Village Lagoa Grande; 09°55'02"S, 037°16'42"W; 18 Apr. 2011; fl; D. G. Oliveira et al. 145 (CSTR 3024). • Sergipe state, Canindé de São Francisco, fazenda Maringá; 09°39'36"S, 037°47'22"W; 08 Apr. 2011; fl., fr; A. A. B. Silva & M. P. Souza 20 (EAC 49891).

**Remarks.** Due to our incomplete knowledge, *T. cearensis* was previously considered endemic to Caatinga areas in Ceará state, Brazil (BFG 2015, 2018; Govaerts et al. 2020). Recently, Santos et al. (2019) expanded it as endemic to the Caatinga domain in the states of Alagoas, Paraíba, Rio Grande do Norte, and Sergipe. Here, we report the first occurrence of that species in Guyana in





**Figure 3.** Distribution of *Tragia cearensis* in South America; specimens collected in the Brazilian Caatinga (circles) and the new record from Guyana (square).

an area of savanna vegetation at 120 m a.s.l. (Fig. 3). Disjunct distributions in the Euphorbiaceae family are not uncommon. Species such as *Croton argyrophyllus* Kunth, *Gymnanthes boticario* Esser, M. F. A. Lucena & M. Alves, *Sapium argutum* (Müll. Arg.) Huber, and *Sebastiania larzensis* Croizat & Tamayo are disjunct in dry areas of South America (Santos-Silva et al. 2010; Siqueira-Filho 2012; Oliveira et al. 2013; Cordeiro et al. 2018; Govaerts et al. 2020). In *Tragia*, species disjunctions only been reported for *T. friesii* Pax & K. Hoffm. in South America (Múlgura de Romero and Gutiérrez de Sanguinetti 1989). According to the IUCN (2001) criteria, *T. cearensis* is Least Concern, occurring in several conservation areas: the Seridó Ecological Station (Estação Ecológica do Seridó) and in the Stoessel de Brito Ecological Reserve (Rio Grande do Norte state), Francy Nunes Natural Heritage Private Reserves (Ceará state), and Fazenda Tamanduá Natural Heritage Private Reserves (Reserva Particular do Patrimônio Natural, Paraíba state).

## Discussion

The Guyana collection (Jansen-Jacobs et al. 4017) was labeled as *Tragia volubilis*, but did not have any of the

diagnostic characteristics: glandular trichomes (short, pedicellate or capitate), pistillate flowers with long pedicels, and seeds light brown with a papillose coat (Múlgura de Romero and Gutiérrez de Sanguinetti 1989; Santos et al. 2019). This combination of characters is slightly different from what was found in Guyana specimens by Gillespie and Armbruster (1997), as they did not find glandular trichomes in their study. At any rate, the collection that we report in this article is compatible with the morphological concept of *T. cearensis*, based on flowers and fruits with short pedicels (1–1.2 mm long) and ovary without capitate glandular trichomes (Santos et al. 2019). Seeds with large papillae, such as those found on *T. cearensis* (50–100 µm), are not frequent in South American species (Múlgura de Romero and Gutiérrez de Sanguinetti 1989). *Tragia cearensis* is morphologically similar to *T. friesii* because some specimens have similar leaf shapes, but they can be differentiated by the absence of capitate glandular trichomes at the apices of the stems (vs apex densely covered with capitate glandular trichomes in *T. friesii*) and seeds dark brown-reddish and verrucose (vs brown and tuberculate). Our detailed analyses revealed, for the first time,



long capitate glandular trichomes at the bases of the petiole and leaf blade (Fig. 1D), which are useful for recognizing *T. cearensis* as they can be observed in both the reproductive and vegetative stages.

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## Authors' Contributions

WPFSC identified the species, and conceived and wrote the manuscript; SMAS contributed to the discussion, review, and approval of the final manuscript; AMT prepared the maps and contributed to the discussion; ALM and MFS contributed critical reviews; MFS obtained financial resources to fund the research.

## References

- Bachman S, Moat J, Hill AW, de la Torre J, Scott B (2011) Supporting red list threat assessments with GeoCAT: geospatial conservation assessment tool. *ZooKeys* 150: 117–126. <https://doi.org/10.3897/zookeys.150.2109>
- BFG (2015) Growing knowledge: an overview of seed plant diversity in Brazil. *Rodriguésia* 66: 1085–1113. <http://doi.org/10.1590/2175-7860201566411>
- BFG (2018) Brazilian Flora 2020 Innovation and collaboration to meet Target 1 of the Global Strategy for Plant Conservation (GSPC). *Rodriguésia* 69: 1513–1527. <http://doi.org/10.1590/2175-7860201869402>
- Cardinal-McTeague WM (2018) The systematics and evolution of Euphorbiaceae tribe Plukenetieae. PhD dissertation, University of Ottawa, Ottawa, Canada, 279 pp. <http://doi.org/10.20381/ruor-22460>
- Cardinal-McTeague WM, Gillespie LJ (2016) Molecular phylogeny and pollen evolution of Euphorbiaceae tribe Plukenetieae. *Systematic Botany* 41: 329–347. <https://doi.org/10.1600/036364416X691759>
- Cordeiro WPF, Melo AL, Athiê-Souza SM, Esser H-J, Sales MF (2018) Reinstatement of *Sapium sceleratum* (Euphorbiaceae), an endemic species from Northeast Brazil, and new circumscription of *Sapium argutum*. *Phytotaxa* 348 (1): 023–03. <https://doi.org/10.11646/phytotaxa.348.1.3>
- Gillespie LJ (1994) A new section and two new species of *Tragia* (Euphorbiaceae) from the Venezuelan Guyana and French Guiana. *Novon* 4: 330–338. <https://doi.org/10.2307/3391440>
- Gillespie LJ, Armbruster WS (1997) A contribution to the Guianan flora: *Dalechampia*, *Haematostemon*, *Omphalea*, *Pera*, *Plukenetia*, and *Tragia* (Euphorbiaceae) with notes on subfamily Acalyphoideae. Smithsonian Institution Press, Washington, DC, USA, 48 pp. <https://doi.org/10.5962/bhl.title.103726>
- Govaerts R, Barker C, Carter S, Davies S, Esser H-J, Fernández Casas FJ, Gilbert M, Hoffmann P, Radcliffe-Smith A, Steinmann V, van Welzen P, Whitmore T (2020) World checklist of Euphorbiaceae. Royal Botanic Gardens, Kew, UK. <http://apps.kew.org/wcsp/>. Accessed on 2020-5-1.
- IUCN (2019) Guidelines for using the IUCN Red List categories and criteria. Version 14. Standards and Petitions Committee, IUCN, Gland, Switzerland, 113 pp. <http://www.iucnredlist.org/documents/RedListGuidelines.pdf>. Accessed on: 2020-8-27.
- Medeiros D, de Senna-Valle L, Valka AlvesRJ (2013) Revalidation of the genera *Bia* and *Zuckertia* (Euphorbiaceae) with *B. capivarensis* sp. nov. from Serra da Capivara, Brazil. *Nordic Journal of Botany* 31: 595–602. <https://doi.org/10.1111/j.1756-1051.2012.01616.x>
- Múlgura de Romero ME, Gutiérrez de Sanguinetti MM (1989) Actualización taxonómica de *Tragia* (Euphorbiaceae) para Argentina y regiones limítrofes. *Darwiniana* 29: 77–138.
- Múlgura de Romero ME (1991) Sinopsis del género *Tragia* L. (Euphorbiaceae) del Paraguay. *Candollea* 46: 521–532.
- Oliveira LSD, Moro MF, Lughadha EMN, Martins FR, Melo AL, Esser H-J, Sales MF (2013) Hidden in the dry woods: mapping the collection history and distribution of *Gymnanthes boticario*, a well-collected but very recently described species restricted to the dry vegetation of South America. *Phytotaxa* 97 (1): 1–16. <http://doi.org/10.11646/phytotaxa.97.1.1>
- Pax F, Hoffmann K (1919) Euphorbiaceae–Acalyphae–Plukenetia. In: Engler HGA (Ed.) *Das Pflanzenreich IV.147.XI. (Heft 68)*. Wilhelm Engelmann, Leipzig, Germany, 1–108.
- Pax F, Hoffmann K (1924) Euphorbiaceae additamentum IV. In: Engler HGA (Ed.) *Das Pflanzenreich IV.147.XVII (Heft 85)*. Wilhelm Engelmann, Leipzig, Germany, 179–204.
- QGIS Development Team (2016) Quantum Geographic Information System. Open Source Geospatial Foundation Project, v. 2.18 Pisa. <http://qgis.osgeo.org>. Accessed on: 2020-08-18.
- Radford AE, Dickson WC, Massey JR (1974) Vascular plant systematics. Harper & Row Publishers, New York, USA, 871 pp.
- Santos MO, Cordeiro WPF, Sales MF, Santos-Silva J (2019) The genera *Bernardia* Hout. ex Mill. and *Tragia* L. (Euphorbiaceae, Acalyphoideae) in northeastern Brazil. *Biota Neotropica* 19 (3): e20180592. <http://doi.org/10.1590/1676-0611-BN-2018-0592>
- Santos-Silva J, Sales MF, Gomes APS, Carneiro-Torres DS (2010) Sinopsis das espécies de *Croton* L. (Euphorbiaceae) no estado de Pernambuco, Brasil. *Acta Botanica Brasilica* 24 (2): 441–453. <https://doi.org/10.1590/S0102-33062010000200015>
- Siqueira-Filho JAD (2012) Flora das caatingas do Rio São Francisco: história natural e conservação. Andrea Jakobsson Estúdio Editorial, Rio de Janeiro, Brazil, 552 pp.
- Thiers B (2020) Index herbariorum: a global directory of public herbaria and associated staff [continuously updated]. New York Botanical Garden's Virtual Herbarium. <https://sweetgum.nybg.org/ih/>. Accessed on 2020-5-1.
- Webster GL (2007) Taxonomic and nomenclatural changes in American Euphorbiaceae sensu lato. *Contributions from the University of Michigan Herbarium* 25: 235–239.
- Webster GL (2014) Euphorbiaceae. In: K. Kubitzki (Ed.) *The families and genera of vascular plants vol. 11*. Springer-Verlag, Berlin/Heidelberg, Germany, 51–216. [https://doi.org/10.1007/978-3-642-39417-1\\_10](https://doi.org/10.1007/978-3-642-39417-1_10)